Set 24: Comparison of bond types

Skill 24.01: Classify a bond as ionic or molecular
Skill 24.02: Classify a compound as ionic or molecular given the physical properties

Skill 24.01 Classify a bond as ionic or molecular

Skill 24.01 Concepts

Recall that when electrons are shared between atoms with similar electronegativity, a covalent bond is formed. A neutral group of atoms covalently bonded together forms a molecule. Examples of molecules include H_2O, CO_2, and NH_3. In general,

- **Nonmetal + nonmetal = covalent bond**

Skill 24.01 Problem 1

Which of the following compounds contain covalent bonds? $KMnO_4$, NaCN, MnI, CO_2

When atoms lose and gain electrons, they form positive and negative ions that combine such that their charges balance.

Ionic bonds are formed between atoms with large electronegativity differences. In general,

- **nonmetal + metal = ionic bond**
- polyatomic ion + metal = ionic compound (NH_4^+ is the only positive polyatomic)

Skill 24.01 Problem 2

Which of the following compounds contain ionic bonds? MgO, CaH_2, CH_3COOH, $NaClO_4$, HCl

Skill 24.01 Problem 3

Which of the following pairs of elements or ions is very likely to form an ionic bond? Explain.

(a) MnO_4, K (b) Na, F (c) H, CN (d) Na, K (e) C, O

Which of the following pairs of elements is very likely to form a covalent bond? Explain.

(a) Mg, F (b) Na, F (c) Ca, Br (d) C, Cl (e) C, Al

Skill 24.02: Classify a compound as ionic or molecular given the physical properties

Skill 24.02 Concepts

The table below summarizes some physical properties commonly used to differentiate between molecular and ionic compounds

Property	**ionic**	**Covalent (molecular)**
Melting point	High	Low
Boiling point	High	Low
Density	High	Low
Solubility in water	Depends on bond strength	Depends on polarity
Solubility in ethanol	Poor	Depends on polarity
Electrical conductivity of liquid	Good	Poor
Smallest unit (e.g. NaCl, H_2O etc)	Formula units cannot exist independently	Molecules can exist as independent particles
Intermolecular forces	Forces between formula units are strong	Forces between molecules are weak

Skill 24.02 Problem 1

Classify each of the following compounds as ionic or covalent

(a) AB is soluble in water and conducts electricity in its molten state
(b) XY is insoluble in water and is a gas at room temperature
(c) CD is soluble in water and is a liquid at room temperature

Skill 24.02 Problem 2

Element **Z** is found to have these characteristics:

- solid
- conducting
- forms the compound **ZCl** with chlorine

Z is most likely from which group on the periodic table

Element **Z** is found to have these characteristics:

- solid
- semiconducting
- forms the compound $\mathbf{Z_aO_b}$ with oxygen

Z is most likely from which group on the periodic table